Project Title: The Future of Wildland Fire Management in a World of Rapid Change and Great Uncertainty: Innovative Perspectives from Futures Research

Final Report: JFSP Project Number 12-2-01-61

Date: September 19, 2014

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This research was sponsored in part by the Joint Fire Science Program. For further information go to www.firescience.gov

I. Abstract

Wildland fire management faces unprecedented challenges in the 21st century: the increasingly apparent effects of climate change, more people and structures in the wildland-urban interface, growing costs associated with wildfire management, and the rise of high impact fires, to name a few. Given these significant and growing challenges, conventional fire management approaches are unlikely to be effective in the future. Innovative and forward-looking approaches are needed.

This study explored wildland fire management futures by employing methods and diverse perspectives from futures research. To gain foresight for wildland fire management, we convened a foresight panel consisting of professional futurists and wildfire professionals, and engaged the panelists in a series of structured online discussions. Panelists in this study were mostly outsiders to the wildfire community. Seven leading academic and professional futurists plus two wildfire professionals were recruited to provide their insights and perspectives on the future of wildland fire management.

There are five broad areas where futures panel members were in full agreement: (1) The level of uncertainty about external developments and future conditions that will set the context for wildland fire management is significantly greater than is recognized in the Quadrennial Fire Review (QFR) and current planning; (2) As conditions change, the traditional fire prevention and suppression approach to wildfire management will prove unsustainable; (3) A new fire resilience approach is emerging as an alternative to traditional viewpoints and practices; (4) All the major strategies needed to implement this fire resilience approach are already familiar to wildfire managers; (5) There are strong short-term barriers to adopting the fire resilience approach, but futures panel members believe its adoption is nearly inevitable between now and mid-century.

II. Background and Purpose

Wildland fire management faces unprecedented challenges in the 21st century. The list of major challenges is well known in the wildfire community, and includes:

- The number, size and intensity of wildland fires have increased in many parts of the world in recent decades, and they are expected to continue to increase in the decades ahead due to projected climate change (Moritz et al. 2012, Stephens et al. 2013). Factors driving increased frequency and size of fires include rising temperatures, longer fire seasons, earlier spring snow melts, and an accumulation of forest fuels in many areas due to decades of fire suppression.
- More people and structures in the path of wildland fires have increased the social and economic impacts of fire activity. Related trends include population growth, sprawling development patterns, growing multiple and seasonal homeownership, amenity migration, and interregional population shifts to the West and Southeast (Hammer et al.

2009). Baby boom generation retirements over the next 20 years are expected to intensify most of these trends.

- The cost of wildfire suppression has grown alarmingly and suppression costs are only a small fraction of the full direct, indirect, and post-fire costs associated with wildfire. According to Zybach et al. (2009), suppression costs represent no more than 10 percent of actual wildfire costs to society. Studies have estimated that total economic costs can be 10 to 50 times (or more) suppression costs.
- An increase in large "… fire events that cause catastrophic damages in terms of human casualties, economic losses, or both" (San-Miguel-Ayanz et al. 2013, p. 11). These large wildfires are distinguished by the scope and scale of their impacts. According to Williams (2013), 0.1 percent of wildland fires account for about 95 percent of total area burned and 85 percent of the total costs of suppression. Carbon emissions associated with high-impact fires are positive feedbacks to climate change (Adams 2013).

Given these significant and growing challenges, conventional fire management approaches are unlikely to be effective in the future. Innovative and forward-looking approaches are needed.

Several recent reports have identified challenges, opportunities and risks to help wildfire policymakers and managers plan for an uncertain and changing future. Most prominent among these are the Quadrennial Fire Reviews (QFRs), a strategic assessment process carried out by the five federal fire management agencies and their partners in the wildland fire community every four years to help guide budgeting and strategic planning. Modeled roughly after the Department of Defense's Quadrennial Defense Review and facilitated by The Brookings Institution, the process has been carried out twice to date (USDA and USDI 2005, USDA and USDI 2009). The next QFR is currently being conducted by the strategic management and technology consulting firm Booz Allen Hamilton.

This study offers a supplemental and alternative approach to the QFRs, exploring wildland fire management futures by employing methods and diverse perspectives from futures research. Futures research is a transdisciplinary social science that uses an array of methods and perspectives to examine alternative possible, plausible, and preferable futures (Bengston et al. 2012). The goal of futures research is to produce strategic foresight, defined as "… the ability to create and maintain a high-quality, coherent, and functional forward view and to use the insights arising in organizationally useful ways; for example, to detect adverse conditions, guide policy, shape strategy…" (Slaughter 2002, p. 104). To gain foresight for wildland fire management, we convened a foresight panel consisting of professional futurists and wildfire professionals, and engaged the panelists in a series of text-based, asynchronous online discussions.

This project does not attempt to "predict the future" of wildland fire management. Successfully predicting the future of complex social-ecological systems is rarely possible because of the prevalence of surprise (Gunderson and Longstaff 2010) and irreducible uncertainties (Carpenter 2002). But wildland fire managers and policy makers must still anticipate and prepare for change

in a rapidly changing world. Futures research offers a productive set of approaches to this challenge. Enhanced foresight resulting from our project may be helpful in preparing for and shaping the future of fire management.

III. Study Description and Location

This study convened a foresight panel and engaged the panelists in a series of structured, text-based, asynchronous online discussions to explore wildland fire management futures. This section describes the main steps in our three-round, online panel method.[1]

Selecting panel members – Seven leading academic and professional futurists plus two wildfire professionals were recruited to provide their insights and perspectives on emerging issues and trends that will likely affect fire management in the future. Table 1 lists the foresight panel members. A panel consisting mostly of wildfire outsiders was chosen because specialists within a field may be unaware of external developments that may have significant effects in the future. Specialists tend to focus within their field and see what they are trained to see. This phenomenon has been termed the "educated incapacity" of experts with respect to perceiving the future: Experts generally "… know so much about what they know that they are the last to see that future differently" (Weiner and Brown 2005, p. 2). People with a broad array of outside perspectives and knowledge spanning diverse fields are more likely to see a wider range of possible and plausible futures. Our panel of futurists included individuals with diverse perspectives and disciplinary roots.

In addition to the seven top-of-the-profession futurists, two highly regarded wildfire professionals were included on the panel: A social scientist known for her work on the human dimensions of wildland fire, and a fire policy expert. These wildfire professionals provided invaluable perspectives and knowledge, and served as a resource for the other panelists when questions about fire management and policy arose during the online discussions. The principal investigators (Olson and Bengston) and research assistants (DeVaney and Thompson) also participated in the online discussions.

Asynchronous computer conferencing – Panelists interacted in three separate week-long rounds of discussion (each about two months apart) using text-based asynchronous computer conferencing, a form of computer-mediated communication in which there is a delay in interaction between contributors. The most compelling advantage of asynchronous computer conferencing over face-to-face meetings and synchronous computer conferencing is its capacity to support reflective interaction, independent of the pressures of time (Wu 2004). This is especially important in the context of developing high-quality and coherent strategic foresight.

[1] See Bengston and Olson (2014) for a more detailed description of the method.

Table 1: Foresight Panel Participants

Futurists:

1. **Peter C. Bishop**: Retired Associate Professor of Strategic Foresight and Director of the graduate program in Futures Studies at the University of Houston; founding board member of the Association of Professional Futurists; President of Strategic Foresight and Development.
2. **Jamais Cascio**: Professional Futurist at OpentheFuture.com; Distinguished Fellow at the Institute for the Future; Senior Fellow at the Institute for Ethics and Emerging Technologies; co-founder WorldChanging.com.
3. **James A. Dator**: Professor and Director of the Hawaii Research Center for Futures Studies, Department of Political Science; former President of the World Futures Studies Federation; co-founder of the Institute for Alternative Futures.
4. **Elizabeth Hand**: Award winning visionary scenario writer; author of fifteen novels and four collections of short stories; faculty member at the Stonecoast MFA Program in Creative Writing at the University of Southern Maine.
5. **Michael Marien**: Former editor of Future Survey, a scanning service published monthly by the World Future Society from 1979-2008; Director of GlobalForesightBooks.org; published a large number of articles in leading futures research journals and other scholarly journals.
6. **Jonathan Peck**: President and Senior Futurist at the Institute for Alternative Futures; futures work spans scientific, economic, political and social changes that can be addressed with an understanding of complex systems dynamics.
7. **David Rejeski**: Director of the Science and Technology Innovation Program at the Woodrow Wilson International Center for Scholars; former head of the Future Studies Unit at the U.S. Environmental Protection Agency.

Wildland fire professionals:

8. **Sarah McCaffrey**: Social scientist with the U.S. Forest Service, Northern Research Station's "People and Their Environments" research unit; internationally recognized expert on the social dynamics of fire management.
9. **John Phipps**: Senior Advisor in the Deputy Chief's Office, State & Private Forestry, U.S. Forest Service; develops policy analysis and options for national fire issues.

Panel groundwork – After identifying our panel members and securing their participation, we asked them to read a set of nine short background papers intended to quickly familiarize them with U.S. wildfire management, policy and issues. Participants were then asked to prepare a short (1 or 2 page) paper or bullet-pointed list stating their initial thoughts about the most significant emerging developments and trends that have potential implications for wildland fire management in the future, drawing broadly from their knowledge and imagination. We encouraged panelists to think broadly about technical innovations, social developments, environmental changes, economic disruptions, changes in government and in the role of the fire management agencies, U.S. developments, global developments, converging developments in different areas, unlikely developments that could blindside the wildfire community, and so on. A spirit of wide-open brainstorming was encouraged, with no idea too wild to hold back.

Round 1 – We analyzed the initial thought papers and identified the following twelve major themes, each of which became a separate discussion thread in the first round of online

discussion: Climate Change, Monitoring, Serious Games, Bioengineering, New Firefighting Technologies, Insurance, Risk Assessment, Economic and Political Context, Value Change, Fire-Resistant Designs and Materials, Public Education and Engagement, and Policy Tools. Within the online conferencing platform, each topic in Round 1 began with a "conversation starter" which summarized the ideas brought up in participants' initial thought papers, posed broad questions related to the topic, and invited participants to jump into the discussion. Panel members elaborated on their initial thoughts, contributed new ideas, and reacted to and built on each other's ideas.

Round 2 – In the second round of discussion, panel members provided reactions to three mini-scenarios developed by the project leaders. This approach is similar to futurist Jim Dator's alternative futures method, in which multiple archetypal images of the future are used to stimulate broad thinking about the future context for an organization, community, or subject area (Dator 2009). The three scenarios described a wide range of plausible social, economic and technological contexts for fire management in the future, including "collapse" (or slow unraveling), "continue" (or business as usual), and "transformation" (a surprisingly positive future). For each scenario, participants were instructed to consider the following questions: What significant changes in wildfire management could result from (or would be required by) this scenario? How would wildfire management need to adapt to make the best of this possible future?

Round 3 – The third and final round included four discussion threads: (1) Actions and strategies appropriate in all three scenarios, (2) Does the new paradigm, developed in Round 2, 'work' in all three scenarios? (3) Institutionalizing foresight in the wildfire management community, and (4) A "water cooler" forum for open discussion of any topic.

The first of these discussion threads was motivated by the need to identify robust actions that would be appropriate across a wide range of potential future conditions. Participants were asked to look again at the three scenarios used in Round 2 and discuss fire management ideas that would be suitable given the circumstances of at least two or of all three of the scenarios.

The second discussion thread, "Does the new paradigm 'work' in all three scenarios?," focused on a paradigm shift in wildfire management that first emerged in the initial thought papers and grew throughout the first and second rounds. The essence of this paradigm shift is that the current prevailing "war on fire" paradigm (focusing heavily on suppression) will increasingly fail and that we need to embrace a new paradigm of wildfire management that focuses on learning to live with fire and creating fire resilient communities. Panelist John Phipps proposed a "2050 Vision" in Round 2 that was a good articulation of this perspective and was used as an example of the new paradigm in this discussion forum. Participants were asked to be specific about how and why a new fire management paradigm similar to this vision would or would not be viable across all three of the scenarios.

Finally, the discussion thread on "Institutionalizing foresight in the wildfire management community" focused on specific recommendations to the wildfire management community about how to improve their foresight capability, institutionalize foresight as a continuous process, and effectively integrate it with decision making and planning.

Analysis – Following the last round, the transcripts of all three rounds of online discussion were analyzed and summarized for the final report. The "open coding" method was used to identify major themes in the text, an approach that is well suited to capture rich themes and uncover unanticipated issues. See Strauss and Corbin (1998) for details on the open coding method.

IV. Key Findings

There are five broad areas where futures panel members were in full agreement:[2]

1. The level of uncertainty about external developments and future conditions that will set the context for wildland fire management is significantly greater than is recognized in the Quadrennial Fire Review (QFR) and current planning.

For example, the latest report by the UN Intergovernmental Panel on Climate Change estimates that if the world continues down its current carbon-emitting course, average global temperatures could rise by from 2.6 to a staggering 4.8 degrees Celsius (8.6 degrees F) by the end of the century. On anything near this course, wildfire management would soon become much more difficult, expensive and dangerous to firefighters than managers are anticipating today. Uncertainties about the economy, energy prices and availability, technological change and other factors make very different conditions possible over the decades ahead.

2. As conditions change, the traditional fire prevention and suppression approach to wildfire management will prove unsustainable.

Larger and more damaging fires are becoming more common, and futures panel members see this situation worsening with no end in sight as long as the current approach to wildfire management continues. With the build-up of fuels that constant fire suppression causes, we are self-selecting for fires we cannot control and do the greatest damage.

3. A new fire resilience approach is emerging as an alternative to traditional viewpoints and practices.

The emerging approach is based on an appreciation of the self-regulating processes in nature and an aspiration to "go with the flow" of those processes. It accepts fire as a natural part of the landscape with important ecological functions and emphasizes learning to live with fire rather than waging a war against it. The central goal of this approach is to create fire resilient

[2] See Olson et al. (2014) for more detail about the key findings.

communities, both ecological and human. The new fire resilience paradigm is based on the notion of co-management of risk, with individuals, communities, governments and other organizations learning together what they can each do to create a sustainable approach to wildland fire management.

4. All the major strategies needed to implement this fire resilience approach are already familiar to wildfire managers.

Becoming fire resilient requires well-known strategies such as communities protecting structures with building codes and buffer zones, requiring landscaping that is ignition resistant, designating evacuation routes and safe zones in the community, etc. As communities move toward fire resilience, adjacent areas and backcountry lands would be thinned and treated with fire to make them fire resilient as well. These measures and related strategies are familiar to wildfire managers and there are programs to encourage them, but not on the needed scale. Fire resilience strategies would not just apply to places where people already live, but also to new development in the 84% of the wildland-urban interface across the western U.S. that has not yet been developed. Once communities, adjacent lands and backcountry areas have been made fire resistant, sustainable wildland fire management would then involve maintaining this pattern over time.

5. There are strong short-term barriers to adopting the fire resilience approach, but futures panel members believe its adoption is nearly inevitable between now and mid-century.

If the future evolves along the lines of Scenario 1, with government budgets cut to the bone, the war on fire would end by force of necessity. Communities that become fire-resilient would survive fires without much harm; others would suffer more damage. If future conditions evolve to be more like Scenario 3, with ample resources, a commitment to sustainability and openness to innovation, panelists believe the fire resilience approach would be readily adopted. Resistance to the fire resilience approach would stay strongest longest in the business-as-usual conditions of Scenario 2, but would eventually crumble as landscapes experience more and more catastrophic fires.

V. Management Implications

Facilitating the shift toward fire resilience – Futures panel members used the scenarios to focus discussion on measures for facilitating the shift toward fire resilience likely to be workable across a broad range of future conditions. This put the focus on low-cost, easy to manage measures that might be possible even in the conditions of Scenario 1. Many of these ideas are already being done and only need to be strengthened or continued. Recommended efforts include:

1. Cultivate an adaptive leadership stance where the leader does not have all the answers and a central leadership task is spanning organizational boundaries and facilitating people learning together, experimenting and cooperating to solve problems.
2. Use awards, certifications and fire resilience design competitions to reward and encourage innovation, e.g., a LEEDS-type certification program for fire-resistant homes.
3. Create an ongoing and innovative public relations effort highlighting the fire resilience approach.
4. Connect wildfire management to larger global concerns for sustainability and security with low cost steps such as encouraging studies by organizations like the Worldwatch Institute.
5. Conduct additional social science research to more fully understand the human dimensions of a fire resilience approach.
6. Utilize "serious games" and playable simulations to train first responders and engage communities, homeowners and children.
7. Help educate the political community about the true nature of wildland fire problems.
8. Support the development of a new fire economics that incorporates long-term thinking and the value of life-supporting ecosystem services.
9. Initiate an ongoing dialogue between the wildfire management community and the insurance industry to discuss strategies for moving communities to become more fire resilient, such as supporting efforts to develop more fire resistant structures and helping policy holders understand what they can do to mitigate fire risk.

This section elaborates on management implications for each of these actions that are appropriate across a wide range of future conditions.

1. Cultivate a new leadership stance

The new paradigm of wildland fire management fundamentally assumes a different leadership stance, a stance that in itself is a paradigm shift. One futures panel participant highlighted the need to develop what he called "net-centric leaders" able to provide facilitative leadership across organizations and bureaucratic silos. He argued that the roles, methods, and skills needed for this kind of boundary spanning leadership are quite different from those required for effective leadership within hierarchical bureaucratic organizations. The relevance of this assertion is demonstrated by the fact that virtually every idea presented here involves leading and coordinating across organizational boundaries – with local communities, organizations concerned with sustainability and security, other organizations promoting the fire resilience approach, universities, and others. While good technical leadership is always important, it can "go wrong" when the nature of problems change, as in today's situation where technical leadership is failing to deal with the changing nature of the wildfire problem. Established procedures and technologies – putting fires out, acquiring air tankers, etc. – remain the priority, but this technical approach is making matters worse, changing the problem from natural wildfire to more dangerous and destructive unnatural wildfire.

Today wildland fire managers confront an adaptive problem where adequate responses are still being developed and clear-cut technical fixes are unavailable. It calls for adaptive leadership where the leader does not have all the answers and a central leadership task is to facilitate people learning together, experimenting, and cooperating to develop and apply successful approaches. The new fire resilience paradigm is based on the notion of co-management of risk, with individuals, communities, governments and other organizations learning together what they can each do to move away from today's increasingly fuel-filled landscapes and create a sustainable approach to wildland fire management.

The skills of boundary spanning and adaptive leadership can be learned. Making more training programs in these skills available to wildfire management agency employees could make a critical contribution to the capability to facilitate the shift to a fire resilience approach and deal with other challenging future conditions. Organizations like the National Conservation Leadership Institute can assist in making this kind of training available.

2. Use awards, certifications and fire resilience design competitions to reward and encourage innovation

Awards and certifications for individuals, communities and organizations that promote fire resilience can be used as low-cost incentives even in the depressed conditions of Scenario 1. For example, federal fire management agencies could work with the Green Building Council to develop a LEEDS-type certification program for fire-resistant homes. Fire resilience design competitions could be sponsored or organized with architecture schools, landscape architecture programs and materials science programs at engineering schools. Design charrettes or competitions at leading architecture and planning schools could be used to create and popularize ideas for fire-resistant designs for buildings and communities. An architecture challenge could be done with the American Institute of Architects or a group of architecture schools. Dedicated fire resilience design studios would be easy to build into architecture curricula and might be readily accepted if the fire community encouraged it and helped supply educational materials. Similar activities could be sponsored for landscape architects, focusing on combining the provision of defensible space with other landscape goals such as aesthetics, storm water management, and green infrastructure planning and provision. The American Society of Landscape Architects could co-sponsor such activities.

Competitions for the development of a new generation of fire-resistant building materials and coatings could be sponsored at materials science programs at engineering schools. In all these areas, fire management agencies and organizations could be the catalyst and play a supporting role, but let other organizations take the lead, provide most of the funding and other resources, and get most of the credit.

3. Create ongoing public relations efforts highlighting the fire resilience approach

Most panelists felt the effort should use Smokey Bear, since Smokey is still so well known, beloved and trusted that no one can really replace him as an effective wildfire messenger. He

should appear in traditional formats such as posters and PSAs, but he should also have his own strong and vibrant presence on social media, going well beyond his current Twitter account and Facebook page. A person or a small group of social media professionals who are savvy, smart and funny should oversee this "Smokey Avatar" and keep him active. Smokey should carry a new simple central message, replacing the outdated "Only you can prevent forest fires." A suggestion that arose in the discussion was "Only you can make your home fire-safe," but there was no intention to recommend that or any other particular message. Rather, panelists thought a major effort involving wildfire personnel and public relations professionals should go into distilling the new message. A suggestion was also made that Smokey may need a few animal friends to join him, each with a crisp message, that taken together sets out the "new story" of how fire resilient communities can live safely in harmony with nature. The story should not be backward looking (e.g., "ending the war on fire") but rather forward looking and positive (e.g., "We can save money, reduce property damage, save lives and create healthy forest ecosystems by doing A, B and C"). Another suggestion for presenting the "new story" is to make more extensive use of information displays that describe the recovery process at sites of previous fires in high visibility areas, with photographs and information about plant species that propagate or benefit by wildfire and how that supports animal life and healthy ecosystems.

There are some public relations efforts already underway that support the new fire management paradigm. For example, the messages in the Ad Council's Fire Adapted Communities campaign (http://fireadapted.adcouncil.org/TV-and-Radio/) are excellent examples of wildfire messages supporting the new paradigm. Describing their wildfire preparedness PSAs on their website, the Ad Council states:

> "Wildfires are an inevitable fact of life for many communities across the country. Wildfire Preparedness is one where its members understand and accept their wildfire risk and have taken pro-active steps to improve the safety and resilience of their homes, landscapes, and community assets to withstand a wildfire. The newest PSAs empower residents to recognize hazards around their home that may be unsafe in the often inevitable event of a wildfire." (http://www.adcouncil.org/Our-Work/Current-Work/Safety/Wildfire-Preparedness)

Campaigns such as this need to become a major focus of an expanded and ongoing effort.

4. Connect wildfire management to larger global concerns for sustainability and security

Futures panel participants were surprised by the lack of connection they found between the field of wildland fire management and networks and organizations concerned with sustainability. One panelist has devoted his career to scanning and reviewing futures and sustainability-oriented literature – books and articles in journals, magazines and newspapers – and reported that, "from what I have seen, the growing incidence and destruction of wildfire and its threat to sustainable development… is not in the literature."

Futures panel members recommend that the wildfire community take a number of low-cost steps to "Go Global" and connect to organizations concerned with sustainability. For example, the Forest Service could encourage the Worldwatch Institute in Washington, D.C. to do one of their excellent papers on the global threat of wildfires and emerging approaches to sustainable wildfire management. Similar initiatives could be made to international organizations like the International Union for Conservation of Nature (IUCN), the world's oldest and largest environmental organization, which publishes over 150 books and reports each year, including many about forests but none, so far, dealing with wildfire. Another suggestion is to work with *National Geographic* magazine, which does excellent future-oriented articles on environmental issues, e.g., a cover feature on "Rising Seas" in the September 2013 issue (pp. 30-57), including a spectacular five-page fold-out map of what the world would look like if all the ice melted, raising seas by 216 feet. Fire management agencies and organizations could encourage them to do an overview of "World on Fire," highlighting vulnerable areas worldwide and illustrating the success of fire adapted communities in living with fire.

The notion of "security" has been broadening in recent years to include food security, energy security, climate change and other concerns. Futures panel members believe that the growing threat of large and destructive wildfires should become part of this expanding conception. One approach panelists discussed is for the wildland fire community to become more deeply involved in the design and implementation of national and international disaster response and mitigation protocols like the Federal Emergency Management Administration's (FEMA) National Response Framework. Panelists believe an important result over time of these kinds of outreach efforts would be to raise the profile of the field of wildland fire management within the domains of sustainability and security, draw new people into the field, and perhaps give it a higher priority within the federal budgeting process.

5. Conduct additional social science research to more fully understand the human dimensions of a fire resilience approach

Much has been learned from fire social science research. For example, past research shows that most people in the wildland-urban interface already understand the risk posed by fire and feel responsible for their property (McCaffrey and Olsen 2012), so the focus of research needs to be on barriers to action besides risk perception. Research is needed on how people feel about more fire on the land, how individuals interpret the concept of fire adaptation, whether the response of fire agencies needs to change during fires with fire adapted communities, and many other topics. McCaffrey, et al. (2013) review key social science research lessons related to wildfire management and identify future research needs.

6. Utilize serious games

Serious games are simulations of real-world events or processes. Although serious games can be entertaining, their main purpose is to train or educate users. They can also be used to engage communities, inform national planning, and solve problems. One panel member identified the following advantages of a game platform:

- A game can provide a whole systems view that very few citizens (or policy makers) ever have. Some call this "topsight," and it is critical in addressing complex systems issues.
- Games built on dynamic simulation models are one of the only ways of teaching people about system dynamics, non-linearity, non-intuitive feedback loops, rebound effects, time lags, etc.
- Games can generate significant amounts of data about player strategies.
- Games scale in a way that other public participation techniques cannot. They shift the economics of engagement to a "software model" where the first person engaged will cost a lot (the price of developing the game) but each successive player drives the cost down a rapidly descending curve.

Serious games and playable simulations can be used in training first responders and others. See, as an example, the Incident Commander game at http://www.incidentcommander.net/ The wildland fire community could also help develop interactive games to engage communities, homeowners and children, giving players a sense for the key parameters that result in high-impact wildfires, actions to take if a fire threat looms near, policy options for dealing with the growing wildfire problem and long term consequences of different policy choices. Games can be designed to work with tablets and smart phones and their use should be encouraged in schools in fire prone areas. Materials to structure discussions in classrooms and on-line about what people are learning from wildfire management games should be developed.

Serious games can also be used to solve real world problems. One panelist commented "If gamers on Foldit can find the structure of a protein key to AIDS development in 3 weeks, while scientists had not been able to solve the puzzle for years, who's to say that they won't come up with creative solutions to sustainability problems, such as wildfire management?" (see Khatib et al. 2011, http://pcmag.com/article2/0,2817,2393200,00.asp). The fire community should work through the Serious Games Association (http://www.seriousgamesassociation.com/) and attend their Serious Play Conferences to team with experienced game developers and organizations that have used serious games. One panel member suggested setting up an internship program specifically targeted toward those with backgrounds in game development and computer simulation with the goal of creating user-friendly games or platforms related to wildfire. The Woodrow Wilson International Center for Scholars has a Serious Games Initiative that has developed games such as Budget Hero in which players balance the federal budget (http://www.wilsoncenter.org/budget-hero). Budget Hero has generated a database of over one million game runs. Serious games are not a panacea, but with 215 million gamers in the U.S. population (average age is 34 and 40 percent are female), they deserve consideration for education, community engagement, and problem solving related to wildfire management.

7. Help educate the political community

Because much of the pressure for immediate fire suppression comes from politicians (Donovan et al. 2011), it will be important to find ways to educate the political community about the true nature of wildland fire problems, the limitations of the current approach and the feasibility of a

fire resilience approach. Educating political leaders will be a significant challenge given the short term focus of the political community and the fact that another election is always just around the corner. Nevertheless, long-term educational efforts need to begin soon, with a realistic expectation that the wildfire problem may have to get worse before most politicians will be open to re-thinking how to deal with it. Futures panel members urge that the wildland fire community make the development of an effective, ongoing informing and engagement process a high priority.

8. Support development of a new fire economics

Several futures panel members made the point that a new paradigm of wildland fire management requires a new fire economics that incorporates long-term ecological thinking and the value of life-supporting ecosystem services. There is a great deal of relevant activity going on in economics that is not visible in the mass media. See, for example, websites of the World Economics Association and the Association for Heterodox Economics as well as the environmentally focused International Society for Ecological Economics. (http://www.isecoeco.org). A new Forest Service Research & Development research work unit that would bring ecological economics concepts and methods into fire economics could develop a new fire economics.

9. Initiate an ongoing dialogue between the wildfire management community and the insurance industry

As a highly regulated and competitive industry, the ability of the insurance industry to provide discounts to policy holders for engaging in mitigation or raising rates for lack thereof is limited. But the exposure of the insurance industry to wildfire risk is growing and will continue to grow in the future, and they might be able to play a useful role in facilitating the shift to fire resilience. We suggest convening a conference and ongoing dialogue between the wildfire management community and the insurance industry to discuss strategies for moving communities to become more fire resilient, such as supporting efforts to develop more fire resistant structures and helping policy holders understand what they can do to mitigate fire risk.

If higher levels of resources are available, many of the above actions could be strengthened and many additional actions could be possible, such as rapid expansion of fuel treatment programs or a program to finance fire resistant home improvements modeled after existing weatherization programs.

If conditions evolve so that strong federal leadership is possible, the federal government could pursue a comprehensive approach, helping to create a new system of firesheds across the country, each with a fireshed council responsible for all aspects of wildland fire including fuels treatment, preparedness planning, suppression response, fire rehabilitation and recovery and promotion of fire-resilient land use building codes and zoning. It could provide incentives to these councils, prioritizing investment based on risk ranking and community performance.

VII. Future Work Needed

Institutionalizing foresight in wildfire management – One of the discussion forums in Round 3 of our online conferences focused on how to improve foresight capability in the wildfire management community and institutionalize it as a continuous process that is effectively tied in with decision making and planning. The QFRs are a good periodic effort, but our panel members agreed that foresight work must be ongoing and institutionalized into routine planning and policy making to have a lasting effect. A single foresight exercise like this one, or even periodic efforts like the QFRs, quickly lose their value no matter how skillfully done and widely embraced. Institutionalizing foresight capacity in wildfire management would help identify emerging issues, driving forces of change, potential wild cards, and a range of plausible scenarios that can help provide the broad context for QFRs and other fire management planning processes.

Panel members identified two main strategies for institutionalizing foresight into wildland fire management. An in-house strategy would involve creating an interagency fire futures unit that would be staffed with several trained futurists, with enough budget and personnel to do high quality and continuing foresight. This unit would be responsible for regular horizon scanning (Bengston 2013) and high-priority projects exploring possible, plausible and preferable fire futures using a range of foresight methods. A growing number of U.S. federal agencies have in-house foresight units.

An alternative strategy is to have one high-level person assigned specifically to contract with futures research organizations and think tanks, purchasing scans and futures surveys on a regular basis, and working closely with fire planners, managers, and policy makers to incorporate the findings into decision making and strategies. Outsourcing foresight activities is a common approach in corporations, but it is important to work hard to ensure that foresight developed by outside consultants is relevant and incorporated into strategic planning and decision making (Day and Schoemaker 2005).

A hybrid approach to institutionalizing foresight, involving both an in-house futures unit and regular use of outside experts, is often most effective. In-house foresight champions know the culture and the ways of the organization or field, and outside experts bring new ideas and perspectives.

VIII. Deliverables Cross-Walk

Proposed	Delivered	Status
Final report describing the study and its findings	In addition to this report, a longer report summarizing the study is: Olson, R., D. Bengston, L. DeVaney and T. Thompson. 2014. Wildland Fire Management Futures: Insights from a Foresight Panel. Institute for Alternative Futures and US Forest Service, Northern Research Station. Available from dbengston@fs.fed.us	Completed
Journal article summarizing the study	(1) Olson, R. and D. Bengston. 2014. Wildfire futures. *The Futurist* Vol. 48, No. 6. (2) Bengston, D. and R. Olson. 2014. Asynchronous computer conferencing for foresight: An example of an online foresight panel method. *Journal of Futures Studies* (3) Bengston, D.N., R.L. Olson and L.A. DeVaney. 2013. The future of wildland fire management in a world of rapid change and great uncertainty: Overview of a futures research project. Pages 34-40 in: Proceedings of 3rd Human Dimensions of Wildland Fire, April 17 - 19, 2012, Seattle, WA. Published by the International Association of Wildland Fire, Missoula, MT.	(1) Forthcoming in the December, 2014 issue of *The Futurist* (2) In review (3) Completed
Two conference presentations	(1) Bengston, D.N. and R. Olson. 2012. The future of wildland fire management in a world of rapid change and great uncertainty: Overview of a futures research project. 3rd Human Dimensions of Wildland Fire Conference, Seattle, WA, April 17-19, 2012. (2) Bengston, D.N., R. Olson, L. DeVaney & K. Nelson. 2013. The future of wildland fire management: Overview of a strategic foresight project. International Symposium on Society & Resource Management, Estes Park, CO, June 4-8, 2013. (3) Bengston, D., R. Olson, T. Thompson, L. DeVaney & K. Nelson. 2013. The future of wildland fire management in a world of rapid change and great uncertainty. Poster presented at the World Future Society annual meeting, Chicago, IL, July 19-21, 2013. (4) Bengston, D. & M. Dockry. 2014. Forest futures in the Anthropocene. World Future Society annual meeting, Orlando, FL. July 11-13, 2014.	(1) Completed (2) Completed (3) Completed (4) Completed. The session on Forest Futures in the Anthropocene included a presentation summarizing the fire futures project.

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